Binational Toxics Strategy
PCB Sources & Regulations
Background Report

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TABLE OF CONTENTS

LIST OF TABLES

Background Information on PCB Sources and Regulations

I. INTRODUCTION

Purpose

This background report is an update to the Polychlorinated Biphenyls (PCBs): Sources and Regulations report dated September 12, 1994. It follows the same general format and uses much of the same language from the 1994 report, with a few modifications. It primarily updates the information on sources of PCBs since 1993, using information from several national and regional databases, and updates the sections on regulatory requirements to include recent changes to the regulations.

On April 7, 1997, the "Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin" (the Binational Toxics Strategy, or BNS) was signed by the environmental administrators of the United States (U.S.) and Canada. The strategy targets many toxic substances for virtual elimination, including polychlorinated biphenyls (PCBs).

The Binational Toxics Strategy identified a four-step process to work toward virtual elimination of each targeted substance:

1. Gather information;
2. Analyze current regulations, initiatives, and programs;
3. Identify cost-effective options to achieve further reductions; and
4. Implement actions to work toward the goal of virtual elimination.

This background report specifically addresses steps 1 and 2, and attempts to answer the following questions:

- What sources potentially release PCBs into the environment? (Section II)

- What regulations affect PCB use and disposal? (Section III)

- What non-regulatory programs encourage reductions in PCB use and disposal? (Section IV)

The objective of this background information is to provide a context for understanding how PCBs are currently used, past uses that might contribute to current PCB releases, and the extent to which the current regulatory structure is encouraging timely and proper disposal of PCBs. From this information, recommendations can be developed to enhance proper PCB disposal.

Background

PCBs, although banned or tightly restricted in almost all industrial and commercial uses because of their persistence and high toxicity, remain a major cause of contamination in the waters of the Great Lakes. Most of the Great Lakes -- as well as many inland lakes -- have fish consumption advisories as a result of PCB contamination.

PCBs refer to a class of chlorinated, chemical compounds that includes numerous different substances favored for their low conductivity, high boiling point, chemical stability, and flame retardant properties. Throughout the 20th century, PCBs were used for many diverse purposes ranging from dielectric fluids to pesticide carriers. As evidence of their toxicity took shape, their uses were curtailed sharply. In a span of less than 20 years, PCBs have moved from one of the most widely used chemicals to one of the most tightly controlled. Today, PCBs represent the only substance singled out for a customized regulatory framework covering its manufacture, processing, distribution, use, storage, and disposal. It is a series of regulations unmatched for any other industrial chemical.

Although most PCB-related activities have been banned or tightly restricted, PCBs still remain in industrial and commercial use in allowable circumstances. PCBs previously released into the environment are dispersed in the air and water and are located in landfills and sediments. Over half of the PCBs manufactured were disposed of prior to the enactment of specific regulations. Consequently, pathways exist for PCB exposure, and PCBs are still considered a threat to human health and the environment. For this reason, PCBs have been included in the Binational Toxics Strategy.

Environmental and Health Concerns

PCBs are classified as probable human carcinogens. As a class of chlorinated compounds, PCBs may include more than 200 different congeners. The specific toxicity varies among chemical products based on the number and position of the chlorine atoms. Tests on laboratory animals show that PCB exposure can cause cancers, tumors, birth defects, reproductive failures, as well as

liver, eye, and gastric tract disorders. PCBs persist in the environment after they are released. Because PCBs are stable compounds, they do not degrade rapidly, and are passed up the aquatic food chain in increasing levels in a phenomenon known as bioaccumulation.

The major source of PCB exposure for the general public is contaminated fish consumption. PCB contamination in fish and shellfish populations has resulted in the issuance of fish consumption advisories and the closure of some fisheries across the country. In addition, PCB exposure may result from servicing PCB containing products such as transformers and other electrical equipment. These activities are also regulated under Occupational Safety and Health Act (OSHA) occupational safety standards at a level designed to protect against skin disorders (29 CFR 1910).

II. Sources of PCBs

From 1929-1977, Monsanto Company, the sole manufacturer of PCBs in the United States, produced 700,000 tons of PCBs. Approximately 75,000 tons were exported from the U.S. All of the PCBs presently in Canada were imported from the United States. Due to their low flammability, PCBs were used extensively for insulating and cooling electrical equipment, particularly in transformers, large capacitors, and fluorescent lamp ballasts. Annual PCB sales peaked at 85 million pounds in 1970. Estimates suggest that 141,000 tons of PCBs remained in service in electrical equipment at the end of 1988.

In the United States and Canada, PCBs are, for the most part, no longer used deliberately in product manufacture. However, they are still used in certain applications as described below. PCBs can be released to the environment from several different sources, some of which include:

- items that contain PCBs introduced intentionally for their useful chemical properties such as transformers, capacitors, and other electrical equipment;
- combustion or incineration of materials containing PCBs;
- environmental sinks of past PCB contamination, such as contaminated sediments;
- inadvertent generation during certain production processes; and
- storage and disposal facilities.

A brief discussion of the different categories of potential PCB sources follows. This section concludes with a discussion of U.S. PCB release data available from several U.S. federal reporting programs. **Appendix A**, a detailed "use tree" of PCB sources, illustrates the diverse applications of PCBs before their general use was curtailed.

A. ITEMS CONTAINING INTENTIONALLY INTRODUCED PCBS

The majority of PCBs were used in the production of dielectric fluids for transformers, capacitors, and other electrical components. PCBs were also used in synthetic resins, epoxy paints and protective coatings, and hydraulic and heat transfer fluids (due to their high boiling point). Because of its widespread and varied use and availability, PCBs may have been used in some applications that may not be known today.

Today, none of these items may be manufactured with PCBs unless the manufacturing process is exempted or excluded from regulation. Current uses must be specifically authorized by regulation. Items such as transformers, capacitors, fluorescent light ballasts, and many other products created before PCBs were banned have a long useful life, and thus, many of these items remain in service. In some cases, owners may not know that items on their property contain PCBs. The challenge for the Binational Toxics Strategy is to develop ideas that result in accelerated phaseout and proper disposal of these and other remaining PCBs.

1) Allowable uses

Toxic Substances and Control Act (TSCA) and Canadian Environmental Protection Act (CEPA) regulations, described in section III authorize certain uses of PCBs within its overall ban. Transformers and capacitors, the largest reservoirs of PCBs still in use, are included in this category.

Under TSCA, all uses of PCBs are banned unless they fall into one of the following categories of allowable uses: (1) "totally enclosed" activity; (2) authorized uses; or (3) exemptions obtained through specific petition. In addition to uses allowed in these categories, several other activities are allowed without explicit authorization or exemption, provided the PCB concentration falls below specific regulatory concentration limits: (1) the inadvertent generation of PCBs; (2) use or processing of excluded products that contain less than 50 ppm PCBs; (3) use or processing of recycled PCBs; (4) applying sewage sludge in accordance with the Clean Water Act and the Resource Conservation and Recovery Act; and (5) burning used oil that contains less than 50 ppm PCBs. **Appendix B** summarizes PCB allowable uses; **Appendix C** summarizes PCB exemptions for manufacturing**.**

Why are certain PCB uses and activities still allowed? EPA has determined that in the U.S.**,** certain PCB uses pose no unreasonable risk. This threshold of "no unreasonable risk" is the underpinning of the TSCA regulatory framework. Some PCB activities that EPA considers to pose "no unreasonable risk" are discussed below.

a. Electrical Equipment

PCBs were used as electric current-insulating material and coolant in electrical equipment to prevent overheating and fires. Electrical products that relied on this type of insulation include transformers, capacitors, voltage regulators, and fluorescent light ballasts. Capacitors containing PCBs were also used in refrigerators, air conditioners, and other large appliances. Industrial

machinery and other electrical equipment also relied on PCBs' fire resistant and insulating properties.

The primary concerns with this type of equipment result from spills, fires, and improper disposal. Identifying all potential owners of equipment containing PCBs is quite difficult.

Transformers and capacitors. Transformers and capacitors are the focus of numerous regulations. Restrictions on allowable uses have tightened over the years since TSCA regulations were first promulgated. Transformer fires may release dioxin from incomplete combustion of PCBs. Regulations, described in more detail in Section III restrict the locations of these items, and require recordkeeping, monitoring, marking and other obligations for owners. However, all phaseout dates for these items have already passed with the last phaseout requirement occurring in 1993 for certain PCB transformers in or near commercial buildings.

The majority of transformers are owned by utility companies. It is not certain which sector owns the majority of PCB capacitors. Regulators are concerned that some of these transformers and capacitors are the last remaining source of high concentration PCBs. This concern is exacerbated by the fact that transformers and capacitors manufactured with PCBs or contaminated during their manufacture are at least 30 years old, some nearing the end of their useful life. As a result, they may become more prone to failures resulting in leaks and spills. Additional concerns are that (1) improper transformer servicing and disposal may result in spills and leaks to the environment, and (2) some building owners may not be aware of a transformer containing PCBs on their premises. As discussed in Section IV, EPA, particularly Region 5, and Environment Canada-Ontario Region (EC) are exploring options to promote a more rapid phaseout of PCB transformers.

Small capacitors and fluorescent light ballasts. Most fluorescent light ballasts manufactured before 1979 contain PCBs. Because of the potential for future environmental liability, many building owners and others responsible for large quantities of discarded light ballasts are exploring combinations of incineration and recycling instead of landfill disposal. Several companies offer cleanup disposal services. Large building owners are likely aware of potential PCBs in their light ballasts, however, smaller owners may not be aware of this potential PCB source.

PCBs may be found in two components of a fluorescent light ballast. The ballast contains a small capacitor. Some capacitors, primarily those manufactured before 1979, contain about 1 ounce of PCB dielectric fluid. The ballast also contains a potting material. Some potting material in fluorescent light ballasts has been found to contain PCBs. Ballasts with non-leaking small capacitors may be disposed of in municipal solid waste landfills. In the U.S., however, if the potting material also contains PCBs, the owner of the ballasts may need to notify the landfill of the PCBs and the landfill may have to segregate the ballasts from organic liquids disposed in the

landfill and monitor its leachate for PCBs. EPA and EC encourage disposal in chemical waste landfills or incinerators. Some states may have different requirements for the disposal of ballasts containing PCBs. In Canada, large quantities of fluorescent lamp ballasts must be stored according to Federal or Provincial PCB Storage Regulations and once ready for disposal, must be disposed as hazardous waste.

Small capacitors may also be found in other equipment such as large appliances such as refrigerators, air conditioners and washing machines, and as starting aids for small motors.

Other electrical equipment. PCBs may still be used in other electrical equipment, although the equipment may not have been designed to contain PCBs. Some of the other electrical equipment which contains a dielectric fluid which may be contaminated with PCBs include voltage regulators, electromagnets, switches, circuit breakers, reclosers, cable, and rectifiers.

b. Non-Electrical uses

PCBs were also used in oils used in hydraulic systems and heat transfer systems. They may still be used in these systems, but the oils are required to contain less than 50 ppm. However, some older hydraulic or heat transfer systems may still have oils with 50 ppm or greater PCBs. These systems are likely to be those which have not been tested recently. The hydraulic systems more likely to contain PCBs would be those systems used in a high temperature operation, such as those found in metal casting plants.

PCBs may still be used in carbonless copy paper at any concentration and in inks at concentrations less than 50 ppm. Such uses may cause paper mills and de-inking operations handling recycled fiber to generate PCBs in their effluent. PCBs were also used in paints, adhesives, sealants, plasticizers, and as lubricants. As indicated below, many of these uses are no longer allowed under any TSCA or CEPA provisions.

2) Discontinued Uses of PCBs

Several previous uses of PCBs are not authorized or provided for under any TSCA provisions. These items may remain in circulation even if they are no longer produced. The following list illustrates products that have, in the past, contained PCBs although, since 1979, PCBs are no longer allowed in these items at concentrations of 50 ppm or greater, or in some cases, at any concentration:

> Adhesives, construction materials, cutting oils, dust control agents, fuel tank coatings, gaskets, inks, oil/lubricants for vacuum pumps, air compressors, and gas transmission

turbines, paints, pesticide carriers, plastic electrical cable insulation, plasticizers in rubber, plasticizers in synthetic resins, sound deadening felt, and viscosity testing liquids.

B. COMBUSTION OF MATERIALS WITH PCBS

Section 112(c)(6) of the Clean Air Act Amendments (CAAA) of 1990 requires that the EPA identify sources of alkylated lead compounds, polycyclicorganic matter (POM), mercury, hexachlorobenzene, polychlorinated biphenyls (PCBs), 2,3,7,8-tetrachlorodibenzofurans (TCDF), and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). These seven pollutants are among the pollutants of concern identified by the International Joint Commission of the United States and Canada, and the Great Lakes Commission, as well as EPA's Great Waters Program because of their persistence and tendency to bioaccumulate in the environment. These identified Section 112(c)(6) sources together account for over 90% of the aggregate PCB air emissions for each pollutant.

EPA conducted an inventory of Section 112 (c)(6) pollutant estimates in a 1990 Clean Air Act Inventory. In this inventory, quantifiable emissions were estimated nationally to 0.157 tons/year (315 lbs.). **Appendix D** illustrates the PCB source categories for air emissions represented under Section 112(c)(6), with each category measured in lbs./year. Due to a lack of emissions information and data, estimates for some sources of PCB air emissions could not be quantified. These sources include: auto scrap burning; environmental sinks of past PCB contamination; PCB spills, leaks, transformer fires, and other uncontrolled or accidental fires; treatment, storage, and disposal facilities; and landfills.

C. ENVIRONMENTAL SINKS WITH PCBS

PCB sediment contamination in waterbodies is an ecological and human health issue of concern. Contaminated sediments pose potential risks to aquatic life by making areas uninhabitable for benthic organisms, and by affecting fish and wildlife by contributing to the bioaccumulation and biomagnification of contaminants in the food chain. Ultimately, PCB-contaminated sediments can pose a threat to human health when the pollutants in sediments can bioaccumulate in edible aquatic organisms.

All 42 existing Areas of Concern (AOCs) in the Great Lakes Basin have contaminated sediments. In approximately half of these AOCs, PCB contaminated sediments are a source of identified impairments to the ecosystem. Several of these sites contribute PCBs to the lakewide ecosystem and contribute to lakewide impairments.

D. INADVERTENT GENERATION OF PCBS

Any chemical process that involves carbon, chlorine, and elevated temperatures may inadvertently generate PCBs. EPA has estimated that up to 200 chemical processes may inadvertently generate PCBs. Many of these processes involve the production of chlorinated solvents. In addition, numerous other products, such as paints, printing inks, agricultural chemicals, plastic materials, and detergent bars, may contain inadvertently generated PCBs.

In 1984, EPA weighed the health and environmental risks and the economic costs of allowing these processes to continue. At that time, EPA concluded that the quantity of PCBs released to the environment from these ongoing processes was inconsequential compared to the quantity of PCBs released to the environment from items that contained intentionally introduced PCBs. EPA also believed that most of the chemical processes with unknown PCB concentrations were produced in low volumes and that the majority of products were already less than the regulatory levels noted below. EPA also recognized that the high costs associated with eliminating the low risks posed by inadvertently generated PCBs would place an excessive cost on society in light of the minimal reductions in public health risks that would accrue.

For these reasons, EPA decided against an outright ban of these processes, due to the potential for a major disruption in commerce. Instead, EPA decided to add certification, recordkeeping, and reporting requirements to facilities that inadvertently generated PCBs, in combination with the following specified regulatory concentration limits for air and water releases. Inadvertently generated PCBs vented to ambient air must be less than 10 ppm. The amount of inadvertently generated PCBs added to water discharged from a manufacturing site must be less than 100 ppb. The concentration of inadvertently generated PCBs in products leaving any manufacturing site or imported into the United States must have an annual average of 25 ppm, with a 50 ppm maximum. The concentration of PCBs in detergent bars must be less than 5 ppm.

E. STORAGE AND DISPOSAL FACILITIES

Under TSCA regulations, PCBs and items containing PCBs must be disposed of in specified disposal facilities or by using specified decontamination procedures. TSCA and Canadian Provincial regulations outline operating standards and procedural requirements for incinerators, chemical waste landfills and other disposal facilities. However, releases of PCBs may occur from containers or items if they are mishandled or break during storage or disposal. In addition, improper disposal may result in generator liability.

STORAGE FACILITIES. PCBs are stored at generator sites and commercial storage and disposal facilities primarily in equipment or containers. The equipment is usually electrical equipment such

as transformers, capacitors, or fluorescent light ballasts which contain PCBs. The containers are typically drums with capacities of 55 gallons or greater, bulk liquid storage tanks, or bulk solid storage containers such as a roll-off. The PCBs stored in containers may be contaminated oil, soil, concrete, equipment, or pieces of equipment. Although the containers and storage areas have to meet specific requirements, the PCBs must still be managed properly within the storage areas to prevent releases.

WASTEWATER TREATMENT PLANTS. Some wastewater treatment facilities in the Great Lakes states detect PCBs in their effluent. The specific source of these PCBs will vary by treatment plant, and may include contaminated sediments, illegally disposed PCBs, and other sources. Some treatment plants have programs to determine the sources of PCBs to their facilities.

INCINERATORS. TSCA or Provincially approved incinerator burning at permitted operating temperatures must destroy PCBs at an efficiency of 99.9999%. The minimum operating temperature for PCB liquids > 500 ppm is 1200 degrees Celsius (2200 degrees Fahrenheit). TSCA operating permits and regulations prohibit adding PCB feedstock during start-up or shut-down. Combustion processes, such as incinerators, boilers, and furnaces, may not reach a high enough temperature to destroy PCBs if they burn items containing PCBs during startup or shutdown. PCBs may convert to dioxins if they are not destroyed properly. EPA does not have as tight control over the operating conditions at boilers and industrial furnaces that burn wastes, or used oil as fuel, as it does for TSCA-permitted incinerators.

LANDFILLS. Landfills can be a potential source of PCB release to the environment due to past disposal of PCB-containing items and materials as well as current, allowable disposal of PCB-containing items and materials. Landfill operators must monitor the groundwater for PCB contamination.

DECONTAMINATION FACILITIES. Decontamination or servicing of PCB-containing items or materials may be conducted in order to recycle or reuse items or materials once the PCBs have been removed. These activities typically involve wiping, soaking, or spraying with solvents. During these activities, measures should be taken to protect against the direct release of PCBs to the environment from the decontamination or servicing areas.

HAZARDOUS WASTE SITES. While EPA does not have comprehensive information characterizing every site where PCBs were spilled or disposed of, it does have estimates of the number of sites historically contaminated with PCBs, including areas of major or long-term spills. In 1991, a characterization of 1,218 sites associated with the National Priorities List (NPL) and 29,461 sites associated with Comprehensive Environmental Response and Liability Information System (CERCLIS) was completed by EPA's Office of Emergency and Remedial Response. PCBs were

characterized as a "predominant" waste type at approximately 20 percent of the NPL sites and approximately 7 percent of the CERCLIS sites. The NPL sites alone were determined to contain approximately 34,070,000 cubic yards of material contaminated with PCBs and other substances. Although the extent of current data is incomplete, these estimates do indicate that there are a significant number of hazardous waste sites contaminated with PCBs, with the potential to serve as future sources of PCB releases to the environment.

F. DATA SOURCES

PCB releases and transfers are reported under several reporting programs, each with a different set of regulatory requirements, and each covering a different subset of the regulated community. The primary sources of U.S. PCB release information are: (1) the Toxic Chemical Release Inventory (TRI); (2) Permit Compliance System (PCS) of water discharges; (3) the National Response Center for information on PCB spills; (4) the Notification and Manifesting Rule for PCB Disposal; and (5) the PCB Transformer Database. For the Great Lakes states specifically, the 1993 Great Lakes Regional Air Toxic Emissions Inventory can also provide useful information regarding toxic air discharges.

Toxic Chemical Release Inventory (TRI). The TRI tracks chemical releases from facilities in the manufacturing sector (SIC codes 20-39) that meet reporting thresholds. TRI thresholds are based on the quantity of each substance used, processed, manufactured, or imported at any of these facilities. **Table 1** shows TRI PCB releases reported in the Great Lakes States for the years 1993 through 1997, both by year and by SIC.

Table 1:
TRI Data, 1993-1997: Great Lakes States

Tri Data by Year:

Year	*Pounds of PCBs*
1993	851,167
1994	831,328
1995	648,689
1996	40,627
1997	1,050,575
Total	**3,422,386**

TRI Data by SIC:

SIC	*Description*	*Pounds of PCBs*
3612	Transformers	2,160,314
3313	Electrometallurgical Products, Except Steel	1,163,289
3334	Primary Production of Aluminum	47,000
3241	Cement, Hydraulic	14,000
2865	Cyclic Crudes & Intermediates	11,000
3563	Air & Gas Compressors	8,880
3274	Lime	7,675
3432	Plumbing fixture Fittings & Trim	4,038
3321	Gray Ductile & Iron Foundries	3,285
3421	Cutlery	1,400
3949	Sporting & Athletic Goods	750
3021	Rubber & Plastic Footwear	505
1446	Industrial Sand	250
	Total	**3,422,386**

Permit Compliance System (PCS) EPA's Office of Enforcement and Compliance Assurance (OECA) maintains the PCS, a database intended to track the permit, compliance, and enforcement status of facilities subject to NPDES permits under the Clean Water Act. Permittees submit to permit authorities effluent monitoring data for all regulated pollutants discharged into waters of the U.S., on a Discharge Monitoring Report (DMR) form. Data from the DMR are entered into PCS.

Historically, EPA has relied on PCS for compliance and enforcement efforts. However, since the PCS is the primary repository of data used to determine pollutant loads to the waters of the United States, its uses are broadening. **Table 2** shows PCB discharges (in kilograms) into several of the Great Lakes. These totals, from 1990 to 1999, represent *reported* values only, and do not

account for discharges originating in Canada. In addition, neither the data nor the data entry into the PCS have been quality controlled for accuracy or consistency. While values in certain locations (e.g., Fox River-Wolf Creek, Wisconsin; and Saginaw, Michigan) have noticeably high reported discharges, it should be noted that these areas have also experienced extensive PCB cleanup efforts.

TABLE 2
Permit Compliance System (PCS)
Reported PCB Discharges

	Reported discharges, 1990-1999
Lake Eerie	**(kilograms)**
Michigan - Maumee River	0.44
Ohio - Sandusky River	0.35
Michigan - Huron	0.16
Michigan - Detroit	0.11
Michigan - St. Clair	4.48
Lake Michigan	
Michigan - Menominfe	4.12
Wisconsin - Green Bay	1.87
Wisconsin - Fox River - Wolf Crk	333.32
Illinois - Western Shore	26.54
Michigan - Grand	15.1
Michigan - Kalamazoo	16.36
Lake Huron	
Michigan - Saginaw	77.71
Michigan - Thunder Bay	3.38
Lake Superior	
Michigan - Iron	0.12
Minnesota/Wisconsin	23.18

National Response Center. Spills of PCBs that exceed one pound must be reported to the National Response Center. **Table 3** quantifies the total number of PCB spills that have occurred annually, from 1993 to 1998, in each of the Great Lake states. The percentage of each state's total, as compared to each year's national total, is also indicated. Of note, the total number of reported spills has decreased each year. While this decrease can be attributed to a number of factors (e.g., less equipment using PCBs, increased knowledge of containment practices), it represents a potentially promising trend.

Table 3: National Response Center: Reported PCB Spills

1993	totals	percent
Total U.S. spills	413	100%
Great Lake States	139	34%
By state:		
Illinois	19	5%
Indiana	16	4%
Michigan	44	11%
Minnesota	7	2%
New York	24	6%
Ohio	21	5%
Pennsylvania	6	1%
Wisconsin	2	0%

1994	totals	percent
Total U.S. spills	340	100%
Great Lake States	123	36%
By state:		
Illinois	13	4%
Indiana	8	2%
Michigan	32	9%
Minnesota	13	4%
New York	19	6%
Ohio	24	7%
Pennsylvania	11	3%
Wisconsin	3	1%

1995	totals	percent
Total U.S. spills	234	100%
Great Lake States	86	37%
By state:		
Illinois	11	5%
Indiana	5	2%
Michigan	22	9%
Minnesota	3	1%
New York	25	11%
Ohio	11	5%
Pennsylvania	8	3%
Wisconsin	1	0%

1996	totals	percent
Total U.S. spills	137	100%
Great Lake States	63	46%
By state:		
Illinois	10	7%
Indiana	3	2%
Michigan	15	11%
Minnesota	2	1%
New York	19	14%
Ohio	6	4%
Pennsylvania	7	5%
Wisconsin	1	1%

1997	totals	percent
Total U.S. spills	105	100%
Great Lake States	38	36%
By state:		
Illinois	5	5%
Indiana	5	5%
Michigan	10	10%
Minnesota	3	3%
New York	10	10%
Ohio	3	3%
Pennsylvania	1	1%
Wisconsin	1	1%

1998	totals	percent
Total U.S. spills	96	100%
Great Lake States	30	31%
By state:		
Illinois	4	4%
Indiana	2	2%
Michigan	4	4%
Minnesota	1	1%
New York	14	15%
Ohio	3	3%
Pennsylvania	1	1%
Wisconsin	1	1%

PCB Commercial Storage and Disposer Annual Reports. EPA promulgated a notification and manifesting rule in 1990 to track PCB waste disposal in a manner similar to Resource Conservation and Recovery Act (RCRA) waste disposal tracking. Under the notification and manifesting rule, storage and disposal facilities must track and report all PCB wastes received. The tracking information is submitted to the different EPA Regions in which the storage and disposal facilities are located. However, EPA has not compiled the data for a national report since 1994.

Under CEPA and Provincial regulations, generators of PCB waste, storage, and disposal facilities must track and report all PCB wastes generated, stored, received, and destroyed. All PCB movements are tracked via a manifest system which indicates the origin, destination, and quantity of PCB waste disposed.

PCB Transformer Database. U.S. EPA developed a database of PCB transformers registered with U.S. EPA as of December 1998. The registration requirement was intended to protect the environment by requiring a uniform, nationwide registration in which the data would be made available to emergency or fire response personnel and building owners. The database provides the best existing and current information on the number of PCB transformers remaining in use. It shows that there are around 18,700 PCB transformers currently registered in use, nationally, with about 25% of the PCB transformers and 21% of the pounds of PCBs located in the Great Lakes States. The primary owners are utilities, followed by companies associated with steel and metal production, the Federal Government, and then the automotive industry. However, the database is new, does not include registrations submitted after its initial development, and has not been thoroughly quality controlled. In addition, some owners of PCB transformers may have not yet registered their PCB transformers. **Table 4** shows the number of PCB transformers and the amount of PCBs in the transformers for each of the Great Lake states.

Table 4: PCB Transformer Database Totals

	Transformers		PCBs	
	Pounds	Percentage	Pounds	Percentage
Total U.S.	18,714	100%	108,625,659	100%
Great Lakes States	5,569	30%	23,291,668	21%
Illinois	502	3%	2,004,171	2%
Indiana	512	3%	1,874,124	2%
Michigan	1,204	6%	6,247,965	6%
Minnesota	340	2%	501,037	.5%
New York	336	2%	1,096,796	1%
Ohio	1,352	7%	7,133,902	7%
Pennsylvania	723	4%	4,076,135	4%
Wisconsin	600	3%	357,538	.3%

Great Lakes Air Toxic Inventory The Great Lakes Regional Air Toxic Emissions Inventory Project developed a multijurisdictional inventory of point and area sources of toxic air emissions that have a potential to impact environmental quality in the Great Lakes basin. The primary tools used in developing this emissions inventory include the Regional Air Pollutant Inventory Development System (RAPIDS), and the Air Toxic Emissions Inventory Protocol for the Great Lakes States. This inventory represents the best available data for calendar year 1993 emissions from point and area sources in the Great Lakes region. **Table 5** shows estimates from the 1993 Air Toxic Emissions Inventory for PCBs, by source category, for all Great Lakes States and Ontario, Canada.

Table 5

PCB - 1993 Estimated Emissions* by Source Category for Point and Area Sources

SIC	Description	Emissions (lbs)	IL	IN	MI	MN	NY	OH	ON	PA	WI
4952	Sewerage Systems	10.0319	X		X	X					
4953	Refuse Systems	7.1030	X	X	X	X			X		X
3599	Machinery Except Electrical, n.e.c.	3.0810			X						
-----	Other Sources *	2.3730	X	X	X	X			X		X
8062	General Medical & Surgical Hospitals	2.1909	X	X	X	X			X		
2679	Converted Paper Products, n.e.c.	1.1881									X

Total Estimated Emissions: 25.9679 lbs

* Each jurisdiction estimated emissions for those sources for which they had data available.
** Other Sources: Individually less than five percent of the total.
(X) Denotes jurisdictions that have contributed emissions data for this pollutant.

The next inventory report, using 1996 data, is currently being developed as of this report. For the 1996 inventory, a mobile source emissions module will be integrated into RAPIDS. This expansion will provide a complete profile for air toxic emissions, including PCBs. EPA also estimated quantifiable emissions nationally as part of an inventory for Section 112(c)(6) of the Clean Air Act. **Appendix D** illustrates the PCB source categories for air emissions represented under Section 112(c)(6), with each category measured in lbs./year.

III. HOW ARE PCBS REGULATED?

PCBs occupy a unique niche in the federal chemical regulatory arena. Singled out for special attention under TSCA and CEPA, PCBs are subject to a management regime largely independent of other environmental laws. TSCA regulations in the US, and CEPA regulations in Canada dictate restrictions on the manufacture, sale, use, disposal, import and export of PCBs. The statutes also include provisions for allowable uses. TSCA and CEPA are not programs delegated to the states or Provinces like many other statutes. States or Provinces may regulate the disposal of PCBs under their own authorities, but in the U.S. those rules cannot be less stringent than TSCA rules.

In the U.S., PCB releases are also targeted by the Clean Air Act (CAA), Clean Water Act (CWA), Resource Conservation and Recovery Act (RCRA), and PCB releases are also reported in the Toxic Chemical Release Inventory (TRI). However, TSCA regulations shape the principal regulatory framework. In Canada, the storage of PCBs is regulated under the Storage of PCB Material Regulations; the export and import of PCBs is regulated under the PCB Waste Export Regulations; and the Chlorobiphenyl regulations control the manufacture, sale, use, and disposal of PCBs. Thus, the costs associated with having PCBs are generally independent of costs associated with other chemicals.

A. TSCA AND CEPA REGULATIONS

TSCA and CEPA establish a legal presumption that PCBs pose an unreasonable risk to human health and the environment, unless EPA or EC determines otherwise. TSCA and CEPA regulations establish an elaborate concentration-based hierarchy that governs all aspects of PCB use and disposal, and dictates specific behaviors that are necessary for compliance. Regulations and policy specify:

(1) How PCBs may be used, processed, distributed, manufactured, exported, and/or imported;
(2) Acceptable storage and disposal conditions;
(3) Spill clean-up requirements; and
(4) Recordkeeping and reporting requirements.

Each of these categories has a separate series of costs associated with it, as well as different thresholds, and criteria for achieving compliance. TSCA regulations, codified at 40 Code of Federal Regulations (CFR) Part 761, apply to all persons who manufacture, process, distribute in

commerce, use, or dispose of PCBs or PCB items, including dielectric fluids, contaminated solvents, oils, waste oils, heat transfer fluids, hydraulic fluids, paints, sludges, and contaminated soils. TSCA regulations apply as well to items that have been in contact with PCBs.

The most significant remaining use of PCBs is as a dielectric fluid in electrical equipment such as transformers and capacitors. For this use, TSCA relies on a theory of increasing regulatory burdens and maintaining management requirements with each higher level of PCB concentration.

- Electrical equipment and oils containing PCBs in concentrations <50 ppm are generally excluded from regulation, with the exception of certain prohibitions on using and burning used oil with <50 ppm PCBs (40 CFR 761.20(d) and (e)); disposal is still regulated if waste streams are diluted to <50 ppm (40 CFR 761.1(b)). In addition, PCB concentrations in oils in heat transfer and hydraulic equipment must be less than 50 ppm.

- Electrical equipment containing PCBs in concentrations between 50 - 500 ppm are known as "PCB-contaminated" electrical equipment. These items have some recordkeeping and disposal requirements, along with specifications for storage, cleanup, and notification; and

- PCBs found in transformers and large capacitors at concentrations >500 ppm are known as "PCB transformers" and "PCB capacitors". These items have requirements for marking, recordkeeping, inspection, cleanup, location, and possibly notification and registration, and limited disposal options.

Costs associated with TSCA and CEPA regulations include inspection, recordkeeping, servicing, marking, location requirements, notification and other issues. **Appendix E** shows the basic framework for TSCA regulations of PCBs. **Appendix F** highlights the major provisions within this framework.

Current regulations are noticeably lacking in requiring the elimination of PCBs in existing -- and allowable -- uses, mainly the use of PCBs in electrical equipment. All previously specified phaseout deadlines have come and gone. Yet, lingering over all PCB owners is the potential for heavy costs associated with leaks, spills, improper disposal, and future liability costs. In addition, TSCA violations could be as high as $27,500 per action for violations that include unauthorized uses or releases.

The implication of this regulatory regime is easily recognizable: lower concentrations of PCBs (or elimination of PCBs) reduces the regulatory burden and compliance costs. Thus, the TSCA and EC messages are clear: eliminate PCBs or move to a lower threshold category, and many costs associated with PCB management disappear. This clear message lies in stark contrast to regulations that affect multiple chemicals.

PCB regulations have been revised periodically based on new risk information. In several instances, EPA has rejected additional outright bans on continued use because the societal costs of doing so far outweighed the benefits of additional risk reduction. For example, in the mid 1980s, EPA imposed additional regulatory requirements (inspection, servicing, registration, labeling, location requirements, etc) on PCB transformers to minimize fire risks instead of immediately banning them because of the estimated multi-billion dollar costs associated with electrical service disruption.

EPA promulgated the "fire rule" in 1985, after reassessing its earlier position on the expected frequency of fire-related incidents involving transformers containing PCBs. PCBs released during transformer fires may be volatilized and converted into other toxic materials such as dioxins. With this rule, EPA imposed restrictions on the locations of electrical equipment containing PCBs, and required registration and marking of PCB electrical equipment. In so doing, EPA determined that the continued use of PCB transformers without these additional restrictions posed an unreasonable risk of injury to health and the environment (see "fire rule," at 50 FR 29170, July 17, 1985).

1) Allowable Uses of PCBs

In general, all PCB uses or activities are banned unless they fit into a specifically listed category. **Appendix B** summarizes the different types of allowable uses in the U.S. PCB activities are allowed in the following categories in the U.S.:

> TOTALLY ENCLOSED ACTIVITIES. "Totally enclosed" activities are defined in TSCA regulations as an activity that results in "no exposure to humans or the environment" (40 CFR 761.20). Regulations list the distribution in commerce of certain intact, nonleaking electrical equipment as totally enclosed activities.
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> AUTHORIZED USES. "Authorized uses" are non-totally enclosed uses that must be specifically authorized by rule (TSCA §6(e)(2)(B)). Generally, authorized uses are based on a finding that the use will not pose an unreasonable risk of injury to health or the environment. Regulations list such authorized uses (40 CFR 761.30). EPA may modify

this list as appropriate. For instance, in April 1994, EPA added analytical reference samples to the list of authorized uses.

EXEMPTIONS. "Exemptions" are required for activities that are not considered totally enclosed, or are not specifically authorized by rule. Individuals may petition EPA to approve a one-year exemption for their specific use. EPA may grant an exemption if it determines that the activity would not pose an unreasonable risk of injury to health or the environment and the applicant has made good faith efforts to develop a chemical substitute. **Appendix C** lists the companies (as of July 1998), that have been granted exemptions for PCB activities.

Until April 1994, these exemptions renewed automatically as long as no changes were made to the allowed activity. In 1994, however, EPA revised the regulations governing renewals of exemptions (59 *FR* 16991-16999). Under the revised regulations, petitioners must submit a certified letter to EPA at least six months prior to the expiration date of the current exemption stating that the specific types of PCB activities have not changed. Any changes to an original exemption are considered a new petition for exemption. The revised regulations apply to exemptions granted on or after April 25, 1994.

2) Disposal / Storage Costs

TSCA, CEPA, and Provincial regulations require specific disposal methods that vary by the type and concentration of PCB items. In the U.S., the pollutant form determines the type of disposal options available. These options include:

(1) incineration in a regulated PCB incinerator;
(2) disposal at a licensed chemical waste landfill;
(3) disposal in a high efficiency boiler;
(4) alternative disposal methods subject to EPA approval;
(5) disposal as municipal solid waste;
(6) decontamination; and
(7) unregulated disposal.

Incineration destroys PCBs and eliminates the potential for future liability that may result from landfill disposal options. However, incineration has the highest short term costs of available disposal options.

EPA and Canadian Provinces approve several different methods for PCB disposal. Several PCB disposal companies operate a variety of commercially permitted disposal facilities throughout the United States and Canada. These companies offer PCB disposal related services that include incineration, alternate thermal treatment, chemical treatment, physical separation, pipeline removal, PCB transformer decommissioning (disassembly/smelting), chemical waste landfills, and biological treatment. A list of these companies is included as **Appendix G.** In addition to these approved facilities, some PCB waste may be disposed of in facilities which do not have a specific EPA permit such as a state approved municipal or non-municipal non-hazardous landfill or a facility. A list of Canadian companies is available by contacting Environment Canada's Environmental Protection Branch at 416-739-5865.

EPA regulations impose a one year time limit on PCB items placed in storage for disposal and certain limitations on storage of PCBs intended to be re-used.

EPA has also promulgated rules that guide the approval process for commercial PCB storage facilities. EPA revised its regulations in November 1993 defining the criteria it will use to evaluate a PCB storage approval application (see 58 *FR* 59372-59374, modifying 40CFR761.65). EPA evaluates commercial storage applications on a case-by-case basis, including the environmental compliance history of the applicant.

3) Recent Changes to the PCB Regulations

In August 1998, EPA amended the PCB regulations affecting the use, manufacture, processing, distribution in commerce and disposal of PCBs (see 63 *FR* 35384-35474, dated June 29, 1998).

The amendments are deregulatory in nature. They provide individuals with more flexibility in their PCB disposal practices, making it easier for the regulated community to comply with the PCB regulations, while continuing to provide protection from unreasonable risk.

The amendments added sections establishing standards and procedures for disposing of PCB remediation waste and certain products manufactured with PCBs; established standards and procedures for decontamination in addition to expanding the list of available decontamination procedures. They also provided less burdensome mechanisms for obtaining EPA permits for a variety of activities by streamlining procedures, focusing on self-implementing requirements for certain disposal activities, and no longer requiring approvals for some decontamination and disposal activities. In addition, controls over the storage of PCBs for reuse were established while more options for the storage of PCBs for disposal were provided..

The major changes to the PCB regulations concerning the disposal of PCBs are described below:

Disposal of "Large Volume" Wastes. For purposes of disposal, "large volume" PCB wastes (e.g., remediation wastes, automobile shredder fluff, etc.) were separated from traditional PCB wastes such as transformers, dielectric fluids and capacitors. The amended rule allows the disposal of remediation waste on the basis of risk rather than its original PCB concentration. The amendments provide flexibility in approving disposal options by establishing decision making criteria, as opposed to promulgating cleanup numbers or waste management techniques for all situation.

Decontamination. The amendments allow the decontamination, without a PCB disposal approval, of many materials that are contaminated with PCBs.

Research & Development. Most small-scale R&D studies are now exempt from permitting. Volume and concentration limits were established with provisions for modification by EPA, thus allowing for the development of innovative disposal technologies without needing to obtain approval from EPA.

4) Proposed Transformer Reclassification Rule

EPA has also proposed regulations that revise the criteria to reclassify transformers to lower regulatory levels. The transformer reclassification rule eases many requirements to reclassify PCB and PCB-contaminated transformers into a lower concentration category that avoids several regulatory requirements.

EPA is currently reviewing the comments received on the draft rule to determine the next steps.

5) Non-liquid PCBs

EPA also plans to issue final regulations on the use of non-liquid PCBs, such as PCBs found in paints, caulks, and rubberized coatings. These materials were likely manufactured prior to TSCA (1976). EPA is currently collecting sufficient data on these non-liquid materials and their uses to be able to make a determination of risk.

B. OTHER U.S. REGULATIONS GOVERNING PCB RELEASES

PCB releases are regulated to some extent under other major environmental statutes. However, these regulations are not the primary driving force shaping decisions about how fast to dispose of PCBs.

Clean Air Act. PCBs are considered Hazardous Air Pollutants (HAPs) under the Clean Air Act. EPA has and will continue to promulgate maximum achievable control technology (MACT) standards for "major source" facilities in any listed source category. However, PCBs are not controlled by a MACT standard as of this report. Major sources are defined as those sources that release 10 tons per year of any HAP, or 25 tons per year in total HAP emissions. As mentioned, EPA has listed the source categories that account for at least 90 percent of aggregate emissions for seven toxic pollutants, including PCBs. **See Appendix D.**

Clean Water Act: The ambient water quality criteria for PCBs in surface waters is 0.001 μg/l. Section 129 of the Clean Water Act specifically bans the discharge of PCBs from PCB, electric transformer, and electric capacitor manufacturers. Facilities may apply to EPA or a state director for an adjustment of their PCB effluent limits if the PCBs in their effluent result from PCBs present in intake water. The facility owner or operator must show that the facility wastewater does not contain a higher PCB concentration than the intake water. (40 CFR 129.05)

TRI: On January 5, 1999 EPA issued a draft rule that proposes to lower the TRI reporting thresholds for PCBs and other persistent bioaccumulative toxics subject to reporting requirements under the Emergency Planning and Community Right-to-Know Act (EPCRA). Currently, the reporting threshold is 25,000 pounds per year for facilities that process PCBs, and 10,000 pounds per year for facilities that "otherwise use" PCBs. If approved, the new rule will reduce these reporting thresholds to 10 pounds per year. Benefits of this reduced reporting threshold will include more accurate and improved agency and public awareness of PCB release amounts, locations, and risks. This knowledge can, in turn, help improve PCB management decision making and policy strategies. Potentially, reduced reporting thresholds may also result in increased PCB management activities for facilities not previously required to report releases.

RCRA: The interplay between TSCA and RCRA for PCB regulation is complex. In general, TSCA regulations apply to all aspects of PCB use and disposal. Because of this specific regulatory framework, RCRA's in-depth storage, treatment, and disposal rules generally do not apply to PCBs. Instead, RCRA regulations defer to TSCA requirements for PCB wastes.

In some cases, however, RCRA regulations apply to PCBs. Following are some examples of the types of situations where RCRA regulations do apply to PCBs:

- Dielectric fluids and electric equipment with dielectric fluids treated under TSCA are not regulated under RCRA (40 CFR 261.8);

- Municipal Solid Waste landfills must have in place programs that detect and prevent PCB disposal (40 CFR 258.20);

! Hazardous wastes containing liquid PCB wastes greater than 50 ppm are prohibited from land disposal unless approval is granted by petition.

! PCBs are a hazardous constituent under RCRA. As a result, the following RCRA regulations apply: groundwater monitoring (40 CFR 264, App. IX); incineration requirements as a POHC (40 CFR 264, 347); and corrective action (40 CFR 264.100).

OSHA: The Occupational Safety and Health Act (OSHA) regulates workplace safety and sets permissible exposure levels for dangerous chemicals. The legal airborne permissible limit (PEL) for PCBs is 1 mg/m^3 (42% chlorine) and .5 mg/m^3 (54% chlorine) averaged over an 8-hour workshift. The National Institute of Occupational Safety and Health (NIOSH) recommends an airborne exposure limit of .001 mg/m3, averaged over a ten hour period. These exposure limits pertain to air levels only. They do not apply to skin contact.

Department of Transportation container requirements: DOT currently requires specialized containers for packaging and transporting liquid and non-liquid PCBs (49CFR178). TSCA allows larger containers for use in transporting PCBs if they are in compliance with OSHA flammable and combustible liquid rules (29CFR1910). EPA is reviewing these container requirements as part of the PCB disposal amendments (see Section VI).

Department of Agriculture Regulations: PCB contamination of foodstocks may occur as the direct result of spills or leaks from PCB equipment, as well as indirectly from packaging contaminated with PCBs originating from recycled carbonless copy paper. The United States Department of Agriculture (USDA) regulates PCB contamination of food products by placing restrictions on food packaging operations and by setting tolerance levels for PCBs in certain foods. (21CFR109). New equipment or machinery for manufacturing food-packaging materials cannot contain or use PCBs. Equipment must be tested for PCBs and removed from use where they could contaminate food-packaging materials.

Safe Drinking Water Act: Under the Safe Drinking Water Act, EPA established maximum contaminant levels for all public water systems in the United States. The MCL for PCBs is 0.0005 mg/l.

CERCLA: Facilities must report disposal of PCBs in quantities greater than one pound to EPA for the purpose of tracking future liabilities. (§102(a)) CERCLA also requires spills greater than 1 pound to be reported to the National Response Center.

Agency-Wide Guidance on the Management of Contaminated Sediments: EPA has the authority under numerous statutes to address contaminated sediments. These statutes include the National Environmental Policy Act (NEPA); the Clean Air Act; the Clean Water Act, the Coastal Zone Management Act (CZMA); the Marine Protection, Research, and Sanctuaries Act (MPRSA); the Resource Conservation Recovery Act; the Toxic Substances Control Act; and the Comprehensive Environmental Response and Compensation Act (CERCLA). EPA is designing a Contaminated Sediment Management Strategy to summarize EPA's understanding of the extent and severity of sediment contamination, to describe the cross-program policy framework in which EPA intends to promote consideration and reduction of ecological and human health risks posed by sediment contamination, and to describe actions EPA believes are needed to bring about consideration and reduction of risks posed by contaminated sediments.

IV. Non-Regulatory Programs

Region 5 and EC's Ontario Region have developed innovative, non-regulatory programs designed to encourage more rapid and proper disposal of PCBs since all remaining regulatory phasedown deadlines for these items have already passed, and many transformers containing PCBs still have a useful life and since the cost of decommissioning, removing, and disposing of a transformer containing PCBs may cost tens of thousands of dollars.

In the U.S., the PCB Phasedown Program was initiated with the overall goal of having all PCB electrical equipment in Region 5 decommissioned. For its initial stage, the PCB Phasedown Program is geared toward transformers, capacitors, and voltage regulators with the highest concentrations of PCBs. EPA has formed a partnership with the utilities in the Region to accomplish this goal.

Utilities participating in the program include:

American Electric Power - Columbus, OH
Commonwealth Edison - Chicago, IL
Consumers Power - Jackson, MI
Dayton Power & Light - Dayton, OH
Detroit Edison - Detroit, MI
First Energy (formerly Ohio Edison and Centerior Energy) - Akron, OH
Minnesota Power - Duluth, MN
NIPSCO (Northern Indiana Public Service Company) - Hammond, IN
Northern States Power - Minneapolis and Eau Claire, WI
PSI Energy - Plainfield, IN

Wisconsin Electric Power Company - Milwaukee, WI

EPA is also seeking the utilities' help with outreach to other customers; influencing other users of PCB electrical equipment to participate in the program; sharing technical expertise with smaller electricity suppliers; and providing incentives to smaller utilities and industrial and commercial customers.

Participating U.S. utilities report that they have already removed over 87% of PCBs in service in electrical equipment through voluntary programs and regulatory requirements. They cited the following barriers to accelerated phaseout of PCB equipment:

- limited disposal options
- storage regulations (facility standards and time limits)
- enforcement penalties
- regulations on retrofilling transformers
- commercial storage regulations
- lack of economic incentives for decommissioning transformers
- liability for handling PCBs and PCB equipment generated by others

EPA is exploring options that might reward more rapid disposal of PCB equipment and is specifically looking for options to build flexibility into enforcement actions for participating utilities and is working work to overcome perceived regulatory barriers that deter utilities from removing their PCB equipment.

EPA will potentially expand the PCB Phasedown Program to other industrial sectors that may have large volumes of PCB transformers.

In Canada, the Small Quantity Outreach Program was designed to target PCB owners within the Province of Ontario. The PCB Outreach Program was a joint effort between EC and the Provincial Ministry of the Environment, and was designed as a catalyst to bring together PCB owners with Federal and Provincial regulatory officials and PCB Contractors to encourage the decommissioning and final disposal of PCBs within the Province of Ontario. Large Utilities have also participated in the Outreach Workshop Program by sharing their expertise and experiences with other PCB owners.